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This original mine moisture changes if coal is treated by washing or by flotation to reduce its ash content, or if it gets wet during storage or transportation.

Since the water and ash in coal are noncombustible, for burning purposes, they are liabilities. In coal analysis it is customary to express findings in raw coal as well as in water-free and ash-free coal. While the heating values of different types of raw coal vary greatly (e.g., lignite runs about 2,000 calories per kilogram, and good quality bituminous coal, from 7,000 to 7,500 calories per kilogram), the heating value expressed on a water-free and ash-free basis varies very little. In young coal types, it is about 6,000 calories per kilogram compared to 8,000 calories per kilogram for first class coal.

Figure 1, taken from an article "The Economical Burning of Hungarian Coal and the Prospects of Standardized Heating Installations," in the Magyar Energiagazdasag (Hungarian Fuel Economy), No 7, 1949, shows this very well. It shows the analysis of important Hungarian coal types on the basis of a uniform heating value of approximately 5,000 calories per kilogram. The diagram shows increasing water content in younger coal types. From Figure 1, it is also evident that the real weight of pure coal (free of water and ash) is about the same for all types. It can also be seen that the fact most characteristic of the age of the coal, namely, its oxygen ( $O_2 + N_2$ ) content, is much higher in younger coal. This accounts for the lower heating value of pure coal in younger types of coal. It is evident that the combustible basis of coal does not show the wide variations in heating value which are found in raw coal. The presence of ash and water influences the heating value. The ash content may be reduced or removed by washing, flotation, or air treatment, and the water content by drying.

#### Coal Driers in Use up to Present

For economy, coal has long been predried. In cement factories, grinding, and in brick factories, evaporation, precedes the burning of coal. Drying is usually carried out with coal lumps 20-30 millimeters in diameter.

Some methods of drying are combined with grinding to accelerate the drying. On the other hand, drying facilitates grinding. Drying at high temperatures also reduces the size of the coal, because internal vapor pressure breaks down the coal. The heat used for drying comes from steam or exhaust gases. In briquette manufacturing, the use of steam, in spite of the larger tubes needed, has proved to be very economical, because the high-pressure steam produced is first used to run turbines for the production of electricity.

As shown in Figure 2, the coal is dried by pressing it through drums heated by axially placed tubes. In briquette factories, steam or air heated plate driers, shown in Figure 3, are frequently used. Here the coal is placed on the top horizontal plate rotating around a vertical axis (see A, B, Figure 3). Small rods push the coal down to the plates below. Finally the coal flows out dry from the bottom plate. When steam is used, the coal layers are heated through tubes. In case exhaust gases are employed for heating, they are conducted above the coal layer and heat it along the surface. But the penetration of heat into the coal is a slow process, and requires large and expensive installations.

The most widely used exhaust gas installation is the drum drier (Figure 4). Heating is usually direct. The feeding of the coal is performed by elevators and built-in distributors or shoveling plates (Figure 5). As the drum rotates, the plates shove the coal into the stream of gas. Meanwhile, the coal slides down along the slightly inclined drum and flows out dry at the bottom. The

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gas is released into the open air together with its water vapor, but without its coal dust, which has been removed in the dust separation chamber. The coal and the gas move across the drum in the same direction, and, for that reason, the coal can be dried at high temperatures without danger of ignition. However, adequate drying requires large installations and removal of the dust is quite complicated.

Recently, revolving gas driers have also been used in briquette manufacturing (Figure 6). This is a modification of the grinding installations employed for firing moist coal dust. The coal is fed into a mill at b by a belt which conducts it into a tube, at a. A hot stream of gas enters with sufficient speed to carry the small particles along, while the heavier pieces fall back into the grinding drum. In the large dropping tube c, the speed of the gas decreases; then in the narrower elevating tube it increases and carries the particles into the so-called separation chamber d. Here the coarser particles are separated and fall through tube e into a grinding mill f, from which the reground particles are re-routed to the first elevating tube.

The fine particles are carried by the gas stream from d into the cyclone q where they are separated and collected in container k, while the steam-laden gas is drawn out by a ventilator h and escapes through tube i into the open. The basic idea in this procedure, as can be seen from the description, is that the hard-to-dry coarse particles are reground during the repeated trip across the drying installation. The temperature of the gas is adjusted to the initial water content of the coal and the degree of dryness desired.

Improvements in these installations have been made. For instance, only one elevating tube and one dropping tube were used, and the two mills were combined. This arrangement is relatively simple and cheap. Its disadvantages are that gas, when leaving at low temperatures, is highly corrosive, that the finely pulverized coal has to be separated from a large amount of gas, and finally that its drying capacity is limited.

#### Burning of Low-Grade Coal

Obviously, drying must always precede the burning of coal. When the temperature reaches 100 degrees centigrade, the water evaporates. In the heating installations currently in use, coal is dried in the furnace and the steam formed escapes with the smoke. This simple method is convenient and works well with coal having a low water content, but for coal with high water content this type of burning has great disadvantages. The question can be raised why the coal is not dried before it is brought to the furnace. Fleissner's procedure aiming to reduce transportation expenses was abandoned because of its high cost and complications.

In the past, there has been little incentive for predrying because: (1) the drying of the previously used better quality coal, which had a relatively low water content, did not present great advantages; (2) the heat in the gas has been utilized for preheating water; but, above a certain temperature, this method resulted in water condensation in the chimney and consequent corrosion.

The situation has now changed as follows:

1. The use of the lower grade coal with higher water content became necessary with the increase in demand for power.
2. The steam preheating of intake water of steam turbines has become so efficient in some important power stations that the exhaust gases cannot be entirely exploited, and the preheating of the incoming air above low temperatures may cause corrosion. Therefore, new methods are needed to make better use of the gases.

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In the Magyar Energiagazdasag, issues 9-12 of 1949, Gencsi's article, "The Effect of the Use of Low-Grade Coal in Power-Station Installations," deals in detail with the decreased heating value and increased ash and water content of low grade coal. He shows, by referring to the data given above in Figure 1, that lignite, yielding 2,045 calories per kilogram (2.4 kilograms produce 5,000 calories), has a water content of 1.17 kilograms, i.e., 20 times higher than the water content of the coal from Peos, of which 0.87 kilogram are required to produce the same number of calories. The ash content of lignite is 0.34 kilogram, while the coal from Tata has an ash content of 0.06 kilogram. Gencsi also states, "it is well known that of the two impurities, water is the least troublesome."

This latter statement is justified under the present conditions. Water, together with the smoke, escapes during combustion and therefore cannot cause trouble. The ash, which in itself does not affect heat production, causes trouble by the formation of clinkers. Clinker formation on the grates, walls, and floor of the firebox, is the source of serious trouble. Another disadvantage of burning powdered coal is that the fine particles which escape with the smoke abrade and wear out the walls of the boilers and contaminate the air in the locality, unless they are removed by expensive smoke screens, in which case storing and transporting the slag present a problem.

Referring again to Gencsi's remark, one has to keep in mind that the difficulties increase in proportion to the water content. Figure 7 shows the heat absorption by the water and ash content during the process of heating up to 1,000 degrees centigrade. It indicates clearly that the heat-absorbing behavior is not consistent. Up to about 105 degrees centigrade, the water from the coal is driven off completely. To vaporize 1 kilogram of water under an atmospheric pressure of 100 degrees centigrade requires 643 calories. On the other hand, the heat absorptivity for ash, whose specific heat is about 0.2 calories per kilogram per degree centigrade, increases proportionally with the temperature, and requires 200 calories at 1,000 degrees centigrade.

It has, therefore, become necessary to predry coal. In some cases the water must be entirely removed, for which purpose hot gases are used.

A coal drier should fulfill the following requirements: (1) It should use, as far as possible, a cheap, low-temperature gas. (2) The gas must be cooled to the desired temperature. (3) The coal must be nearly or, in some cases, entirely dried. (4) The effective drying time must be short. (5) The drier must be of high capacity and must be installed according to need, centrally or with the boiler units. In the latter case it has to be adapted to the capacity and construction of the boiler and should, in fact, become an integral part of it.

None of the driers available at present fulfills the above-stated requirements; therefore, new solutions are needed.

#### Harmful Effects of Water Content of Coal

In power plants, the water content leads to three disadvantages:

1. Coal which is frozen or wet by rain often damages the transportation facilities of the power plants. The openings of coal bins become clogged, the coal piles up, does not flow freely down the chutes, etc.
2. It lowers the capacity of the prepulverizing mill when powdered coal is to be used, and sometimes blocks the mill entirely when the water content is above a certain level. The operating limit varies with the quality of coal and the construction of the mill.

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3. Water delays ignition in proportion to its percentage, and consumes heat.

The effect of water content in the above instances depends on both the percentage and the characteristics of the water. The water may be either internal or surface moisture. Surface water leads to adhesion and ultimate clogging. Milling difficulties are the result of hygroscopic water content.

It is important to know that surface moisture appears both in coal of ancient formation, which contains a slight percentage of water, and in coal of recent origin and high water content, only after the hygroscopic content reaches the saturation level. Not until moisture oozes to the surface do the coal particles stick together. Otherwise they roll smoothly like sand in an hour glass. This we can best observe in coal piles having 0 - 5 millimeter particles.

Two simple instruments were used in my investigation to determine the extent of adhesion which characterizes a coal pile. One is the inclination measure. It consists of a 150 x 100 millimeter plate with a corresponding removable tin frame. After the frame is filled up, it is carefully removed. The excess coal on the sides flows down, and the remaining coal is left in a form whose angle is determined by the quality of the coal. The height of the pile can be measured on a scale and the angle of inclination is determined from the height.

The other instrument is a trough-like funnel whose lower opening can be adjusted from 10 to 50 millimeters. The flow or clogging in this funnel will also be a function of the structure and quality of the coal.

My measurements with various kinds of coal have shown that if the surface is dry, the inclination angle for 0 - 5 millimeter coal increases with the water content, and varies from 45 to 55 degrees. Such coal flows smoothly through a 10-millimeter funnel.

When the surface humidity reaches the degree of the mine humidity, the angle of inclination increases and the coal clogs the funnel. Figure 8 shows inclinations of deep mined, sifted, 0 - 5 millimeter coal from Matranovak and Rozsaszentmarton. The abscissa indicates the water content and the ordinate shows the height and the angle of the incline of the instrument. The data on funnel flow is indicated with a circle along the inclination curve of the coal together with the percentage of water content. From this it appears that the saturation point (when the surface is dry) is very near the mine humidity of the coal.

The values are given in table form as follows:

<u>Coal Deposit</u>	<u>Percentage of Water Content of Coal Flowing Through 10-mm Opening</u>	<u>Approximate Per- cent of Water Content of Coal in Mine</u>
Tata	14	14-16
Matranovak	22-24	25-28
Rozsaszentmarton	32	40-50

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It should be noted that the size of the coal particles influences both the angle of inclination and the flow through the funnel. The inclination increases with the quantity of fine powder, although to a lesser extent than with the increase in water. The two instruments described above also serve for the rapid evaluation of the effect of the powder content in a given coal.

To avoid any misunderstanding, it has to be stated that this water content does not correspond to the hygroscopic water content. In the Tata coal, the hygroscopic water is about 9 percent; in younger coals it is higher. Spread for open-air drying, the coal becomes "air-dry," but coal having a lower water content will absorb water from the air.

#### Transportation Difficulties

The Soviet professor Lurviye, in his book entitled Drying Procedures, describes a drum drier shown in Figure 9. Its purpose is to eliminate clogging caused by surface moisture or by freezing of the coal. The coal is fed in at 1. The inner part of the drum is composed of shovel-like plates, which prevent the coal from cascading down the rotating drum to 2, the outlet. The heating gas enters at 3, below the plates, streams through the coal, and is discharged at 4. The only purpose of the drum drier is to remove surface moisture. It is used centrally and the gas is provided by a special boiler whose temperature can be regulated by controlling the draft.

#### Difficulties in Grinding

The amount of work needed to mill the coal decreases with its water content until the water content reaches hygroscopic saturation. From there on, it remains constant. If the water content exceeds certain limits, the mill parts become gummed and choked, and grinding comes to a complete stop.

The permissible water content varies with the coal and the construction of the mill. The limit is high in grinding-drying mills in which hot air and smoke from the furnace dry and sift the coal. The finer particles are carried by the stream of hot gas to the burner while the coarser parts fall back into the crusher. This procedure is characterized by the fact that all water from the coal enters the furnace in vapor form. A similar procedure is employed in installations where the mill and furnace are built together. However, for fine grinding, which is necessary for low grade "gas-poor" coal, such as the coal from Pecs, grinding-drying mills are not adequate. On the other hand, in high-speed rolling mills the permissible moisture content is so limited that pre-drying is necessary.

In the USSR, pneumatic crushing has been introduced with good results. In this procedure a stream of hot air, together with a mixture of furnace fumes, is employed and the vaporized water content of the coal enters the furnace.

According to an article published in the June 1950 issue of the German periodical Brennstoff, Waerme, Kraft, better results may be achieved by treating the coal before grinding with filtered smoke gas, instead of with high-temperature gas taken from the furnace directly. The powdered coal is segregated from the gas and is blown into the furnace, while the gas, which still contains some coal dust, is conducted into the furnace later. Thus, in addition to all the coal moisture, the smoke gas enters the furnace and cools it. According to the publication, this procedure has been improved lately (Figure 10) by circulating the gas through b (mill), c (dust segregator), and d (fan), and reheating it in h (temperature regulator) by means of the filtered gas, which subsequently escapes through S (smoke stack). Thus, the circulating gas, mostly coal water vapor, effects the drying of the coal entering at a. The air stream g carries the powdered coal fed by the feeder f from

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container e into the furnace. The amount of gas to be removed from this circuit must correspond to the amount produced by evaporation. This takes place after the gas has passed through the heat regulator h and the gas removed is blown by the ventilator i into the furnace, so that in this case, too, all the water vapor enters the furnace.

#### Problems in Burning

Figure 11 shows the amount of heat used by the water and ash content in producing 5,000 calories by the four common coal types given in Figure 1. The abscissa shows the water characteristics of the coal. By assuming a uniform temperature of 180 degrees centigrade for the escaping smoke, we can see the loss due to the water content of the smoke. On the other hand, losses due to ash content, assuming the gas escapes at 1,000 degrees centigrade, are relatively low, and furthermore when the ash cools below 1,000 degrees centigrade, it will transmit heat to the gas inside the furnace. The amount of heat absorbed by the water entering the furnace at 1,000 degrees centigrade, is shown for each of the four kinds of coal. Also shown is the amount of heat liberated by water-free coal and the amount of heat absorbed by the water in the raw coal. For purposes of comparison, we assume in our illustration that there is a uniform heat of 1,000 degrees centigrade throughout the firebox.

The water vapor produced from the 1.17 kilograms of water contained in the lignite type, shown in Figure 1, requires 1,300 calories. Therefore, of the 5,702 calories heating value, only 4,402 calories remain for actual heat production and maintenance. Resulting temperature in the furnace is considerably lower, and as the heat given up in radiation is reduced in proportion to the mass, a much lower vapor production is attained.

A great amount of heat is required to evaporate water from coal with high water content. It is a prerequisite for ignition that the coal fed to the grates be dry. In case of low water content, there is no need for special installations; a low ignition dome and the radiation of the otherwise open furnace will assure ignition. On the contrary, in poor coal, having a high water content, the front of the grates serves as drier. The more elongated ignition dome which encloses the ignition area more completely, and the dome at the back of the grates will insure the necessary heat for drying and ignition. Under the effect of the radiation from the furnace dome, the upper layers of the coal will dry and ignite, and combustion will proceed concurrently with the drying toward the lower layers. For this reason, in coal of high water content, burning will take place only in the central part of the grates, the front part serving for drying the coal and the rear part containing the embers.

Preheated air greatly hastens the drying, but heating the air above 200 degrees centigrade has disadvantages because it endangers the grates supporting the embers. The drying could be improved if the part of the grates where drying occurs could be bathed in a stream of hot air, which would benefit this area. Experiments are now being conducted along this line. Another way to speed drying and ignition in such furnaces is to put burning embers under the coal. This method has been known for a long time. The Czechoslovak mission to the London International Power Congress mentioned it in its report as an efficient means of improving the grate burning of low quality coal. For this purpose, some forward grates were developed.

Another means of hastening the ignition and thereby increasing productivity is by the blowing in pulverized coal. This is described in one of the reports.

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Gencsi, in his above-mentioned article, arrives at the conclusion that drying on grates "is still cheaper compared to the expenses of a preheating installation." Gencsi is correct because none of the currently known installations is adequate for the purpose. One is obliged to compromise with drawbacks resulting from water content, and to try to improve productivity by dome construction, ignition from below, coal powder blasts, etc. But even this does not eliminate other inconveniences resulting from water content.

If we keep in mind the necessity for increasing demands for low-grade coal, such as lignite with its extremely high water content, it will become evident that technical progress will find means to overcome the present drawbacks.

These drawbacks include:

1. Evaporation of the coal moisture is accomplished either by the heat within the furnace or by hot gases derived from the furnace. Consequently, considerable potential heat is lost which otherwise would be added to the heat emitted by radiation.
2. The smoke is laden with water vapor produced in the furnace, which increases its resistance to draft.
3. The vapor-saturated sulfuric acid resulting from the water vapor and the sulfur contained in the smoke, with its high point of condensation, are a corrosion hazard to the heating surfaces of the boiler, to the ventilators, etc.
4. The evaporated water leaves with the smoke gases at their temperature, and, having a greater specific heat, increases the heat loss in the smoke.

#### Tentative Methods of Predrying

Figure 7 shows clearly that the evaporation of the moisture needs a low temperature, and that this temperature can be attained by means of the waste heat contained in the escaping smoke. If the evaporated water does not return to the furnace, and from there to the boiler, the disadvantages indicated under drawbacks 1 - 4 above can be avoided. The following advantages will result: the heat level in the firebox, and consequently the transmission of heat by radiation, will increase. There will be a smaller amount of smoke passing across the boiler, and consequently draft resistance will be reduced. The amount of smoke escaping is lessened, smoke losses are lower, and efficiency is improved.

Because of the lower vapor content of the smoke, the corrosion hazard is reduced. In grate burning, a smaller grate surface is required for coal drying, and no special igniting and radiating domes will be needed in the furnace. Therefore, the furnace opening can be increased, and the heat transmission toward the boiler tubes will increase, which will allow for fuller exploitation of the increased grate productivity.

In heating with powdered coal, dried coal can be ground more easily. By increasing the combustion area of coal within the grate, transmission of the radiant heat rises unless it is hindered by the formation of clinkers. The decrease in vapor formation raises the coefficient of radiation of the coal powder flame, because there is less oxygen available to oxidize the glowing coal particles in the flame. These advantages, resulting from the reduction in smoke gas and water content in grate burning, i.e., lower draft resistance, decrease in heat loss in the escaping gases, and reduced corrosion hazard, are also true for the burning of powdered coal.

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The complete elimination of corrosion hazards is discussed in an interesting proposal made by Elemer Hajdu. He states that the air heated by the residual heat of the smoke could be used for coal drying, since the air does not contain sulfurous or sulfuric acid, has a very low water vapor content, and can absorb much water vapor.

The preheating of poor quality coal having a high water content is an important problem. Since the fall of 1949, with the cooperation of Professor Komondy at the Institute of Technology, and, later on, after the opening of the Thermotechnical Institute, I have been busy working on the problem of coal drying. I take this opportunity to express my gratitude to Professor Komondy and to the directors of the Thermotechnical Institute for their understanding help.

I made my experiments on laboratory size installation, and later on a small size experimental smoke type drier. On the basis of the interesting results obtained, the predrying of coal, in my opinion, meets the requirements mentioned above in items 1 - 5. Pilot studies of a similar nature have been reported recently.

A Czechoslovak committee at the International Power Congress made a report on an 18-square-meter coal drier installed behind a 300-square-meter surface boiler. The lignite coal used was 0 - 13 millimeters in size, its water content 40 percent, and its heating value 2,300 calories per kilogram. The 18-square-meter drying surface was divided into five inclined grate-like surfaces. The smoke entered at a temperature of 240 degrees centigrade, its final temperature was 129 degrees centigrade, the hourly wet-coal consumption 3,340 kilograms, and the weight of the dried coal 2,410 kilograms with 28 percent water content.

That means that evaporation took place at the rate of 930 kilograms of water per hour; the heating value of the coal was therefore increased from 2,300 to 3,400 calories per kilogram. The boiler efficiency with wet lignite is 68.4 percent; with dry lignite, including the drier, and under similar circumstances, is 74.5 percent, yielding 61 divided by 68.4, equal to 8.9 percent improvement. The ignition of the coal is better, and it is possible to improve the productivity of the boiler. According to the publication, the drying process is handicapped somewhat by the fact that smoke leaving the boiler is of low temperature and of too large a volume. Since the speed of the gas passing through the coal particles must be relatively slow in order not to carry away the particles themselves, the drier must be large and hence too expensive. Dr. Joseph Mejstrik closed his report by saying, "In this manner, the drying of lignite with the waste heat of smoke results in increased efficiency and greater heat capacity. In a new modern boiler, which burns predried coal, the process operates in nearly the same way as it would with high-grade coal."

Smirnov, in the Soviet periodical Za Ekonomiyu Topliva, No 8, 1950, describes a 20-ton per hour steam-fed predrier which is installed in front of the grates. It was used in the following manner to attain a more economical method of burning the high water content coal from Bogoslovsk: hot air is blown from below, there are grates toward the rear for the burning of embers and formation of clinkers, and hot air is blown back into the furnace. Figure 12 shows this coal drier with the inlet and outlet cells for heating the gas. The coal slides by its own weight from the container in the boiler house through the drier, at a speed which is regulated by the grates, into the furnace. The hot gases of 550 - 600 degrees centigrade from the boiler pass through the cells, which are built into the drier itself, and rinse and dry the coal.

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The findings in one experiment were as follows: Boiler loading, 19.7 tons per hour, ash content, 32.7 percent, water content, 24.8 percent, heating value, 2,951 calories per kilogram, water content of the dried coal 14.8 percent, grate load, 1,070 x 10<sup>3</sup> calories per square meter per hour. The results disclose that efficiency increases in the dried coal, and that the specific load of the grates can be increased to 1.4 - 1.6 times the amount of raw coal.

The general premises in my studies, started 2 years ago, were essentially the same. The ingenious installations developed in the Soviet Union are similar to the conceptions resulting from my experiments, except that I would prefer a simpler layer-drier in front of the grates, and would make use of the gases escaping at lower temperatures. I have found that, besides the drying, one of the prerequisites of efficient coal burning is the adequate selection and preparation of the coal. The small size coal -- 0 - 5 millimeters -- has to be handled in a different manner than a coarse coal of 5 to 40 millimeters. Therefore, in most cases the coal should be classified according to size, moisture content, and its content of fine powdered coal. This separation can be combined with the predrying process.

Judging from the data published in Czechoslovakia, my conclusions are justified that the problem is less involved in that country, and that it can be solved with a more efficient drier. The surprisingly good results obtained in drying 0 - 5 millimeter coal, as well as 5 - 20 and 5 - 40 millimeter coarse coal, can serve as a basis for further development. I am convinced that predrying low quality, high water content, coal in a fully satisfactory manner will soon be possible. Such driers will completely remove the drawbacks due to high water content in grate burning. In regard to powdered coal, on the other hand, replacing the present crusher-driers will facilitate the crushing of the coal, and at the same time relieve the furnace of the vapor produced by coal moisture. Finally, with the complete removal of coal moisture, it will be possible to increase the heat radiation obtained by the Szikla-Rozinek method.

Technical progress in the near future will make obsolete the question as to which of the two heat-absorbing factors causes more trouble, water or ash. We expect to overcome completely the inconveniences resulting from both. The means to this end is the complete, or at least extensive, predrying of the coal, and the removal in melted form of all or a very large part of the clinkers.

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8. Smirnov, "Brown Coal Burning on Chain Grates," Za Ekonomiyu Topliva, No 1, 1950.

[Appended figures follow.]

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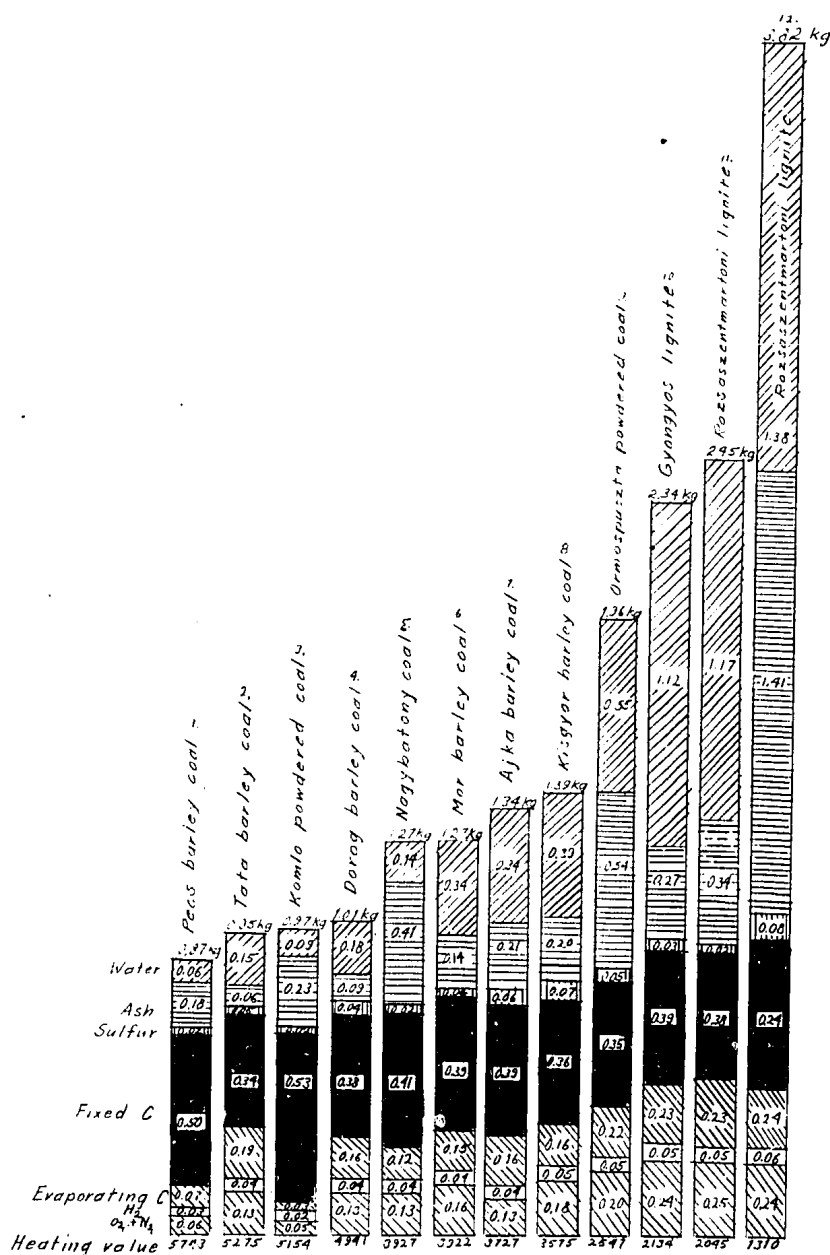


Figure 1. Chemical Combination of Different Coal Types  
With Heating Value Under 5,000

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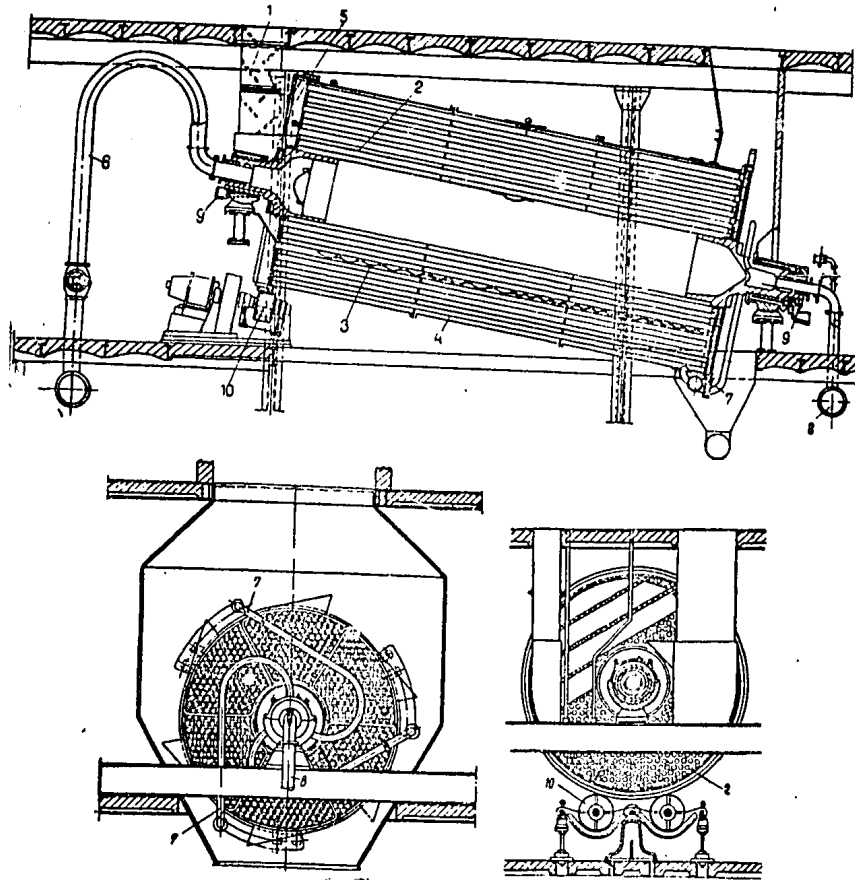


Figure 2. Tubular Coal Drier: (1) Raw coal feeder; (2) Tubes; (3) Pulley;  
 (4) Drum; (5) Elevator plate; (6) Steam inlet; (7) Condenser pipe;  
 (8) Condensed removal; (9) Bearing; (10) Friction drive

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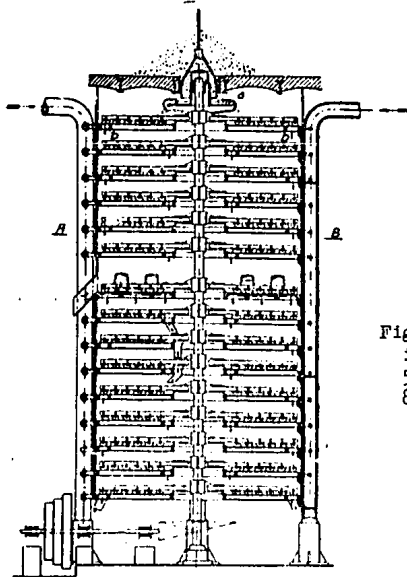


Figure 3. Steam-Heated Drier Plate

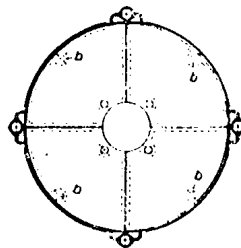


Figure 6. Rotating Milling Drier

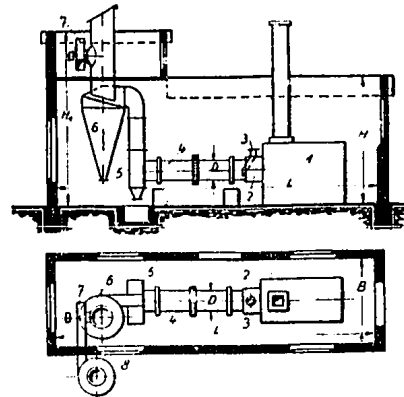


Figure 4. Drum drier: 1. Firing; 2. Gas inlet; 3. Coal feeder; 4. Drier drum; 5. Selector; 6. Dry cyclone; 7. Fan; 8. Wet cyclone

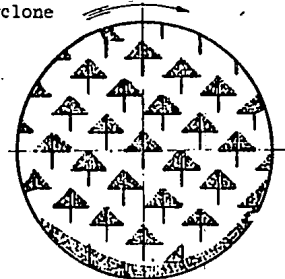
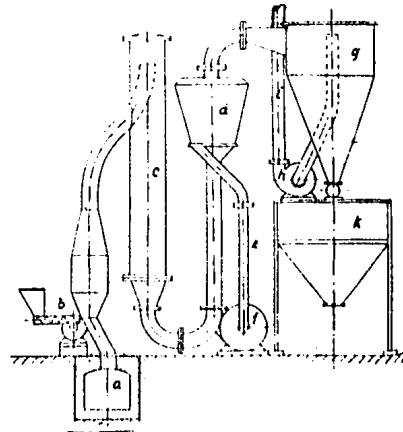


Figure 5. Drum Cross Section With Scattering Plates



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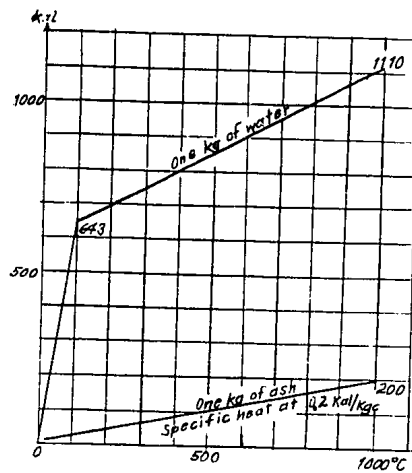


Figure 7. Typical Heat Absorption by Water and Ash Content (atm pressure)

Dr Rozinek's Coal Dryer Employing Smoke Gas

20 April 1950

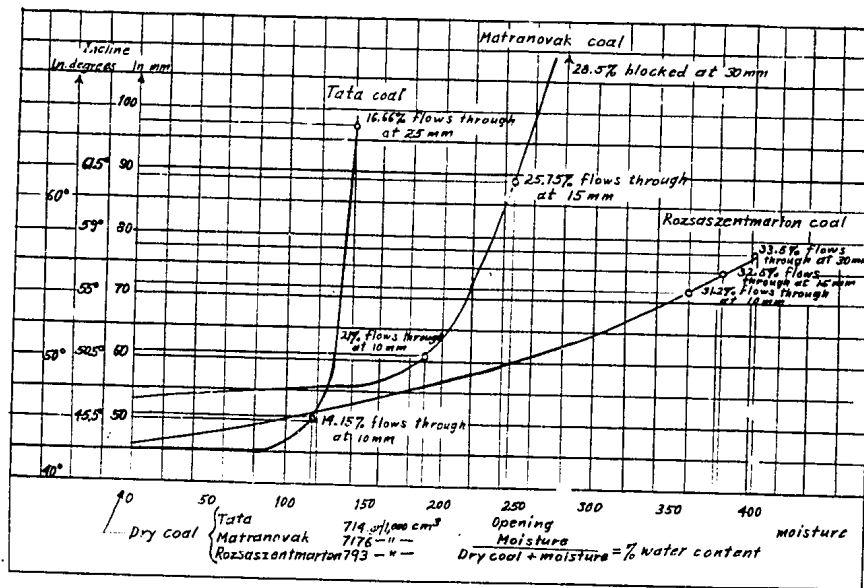


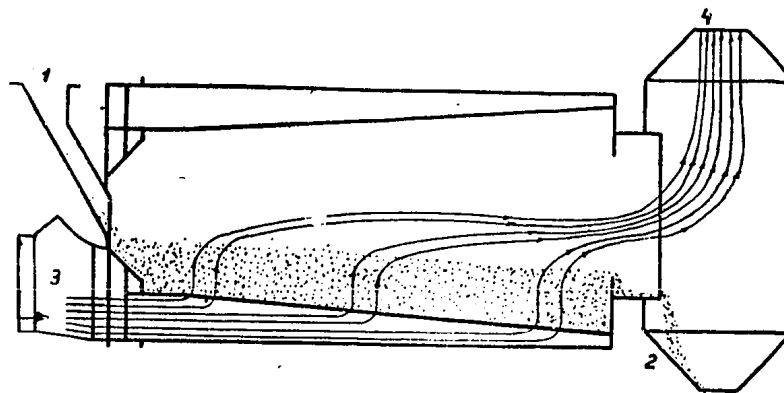
Figure 8. Angles of Inclination and Funnel Data at Different Degrees of Moisture for Three Coal Types

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Rotating Drum Drier

1. Coal feeder
2. Outlet for dry coal
3. Inlet for gas
4. Outlet for gas

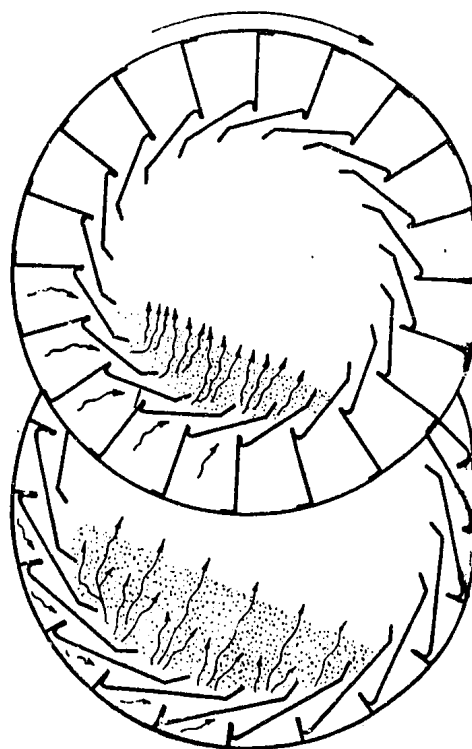


Figure 9. Rotating Drum for Evaporating Surface Moisture

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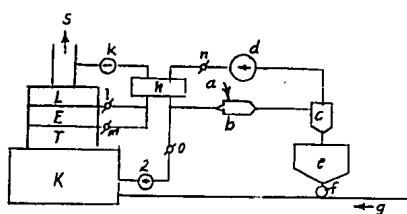


Figure 10. Milling Drier With Circulating Gas and Heat Regulator:  
K=Boiler furnace, T=Superheater, E=Water heater, L=Air heater, S=Smokestack, a=Coal feeder, b=Mill, c=Cyclone, d=Fan, e=Powdered-coal container, f=Powdered-coal feeder, g=Air current, h=Heat regulator, i,k=Fan, l,m,n,o=Regulating valves

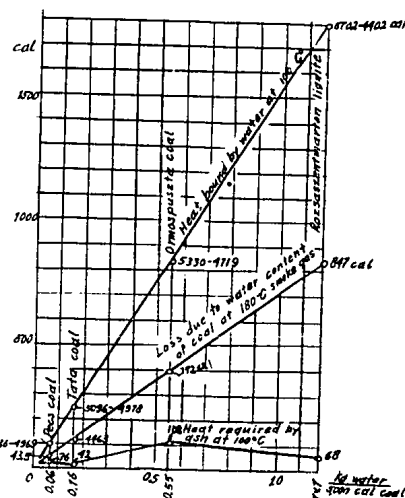


Figure 11. Heat Absorption by Water and Ash Content for 5,000 Calories

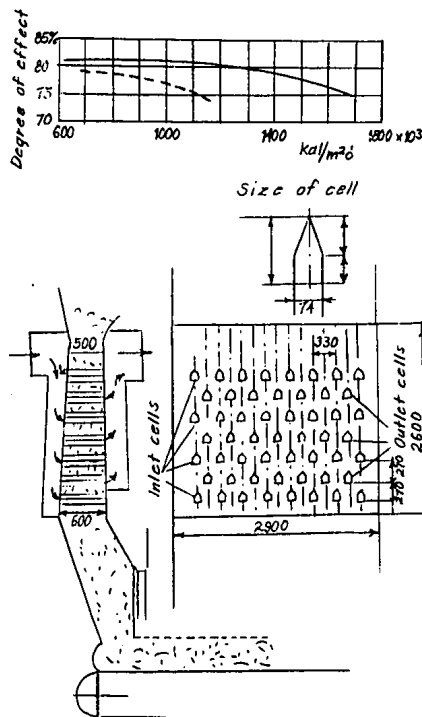


Figure 12. Shaft Drier Mounted in Front of the Boiler

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